

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



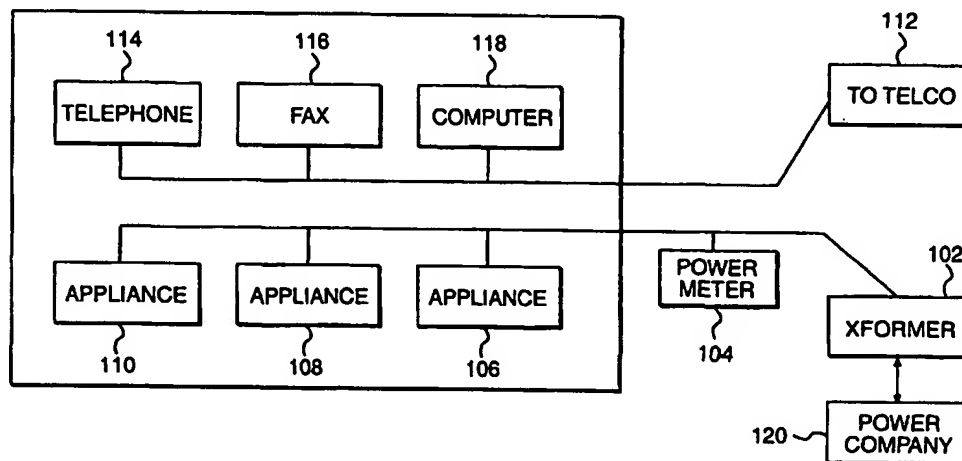
(43) International Publication Date
28 December 2000 (28.12.2000)

PCT

(10) International Publication Number
WO 00/79697 A1

- (51) International Patent Classification⁷: H04B 3/54, 3/56 (81) Designated States (*national*): AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZA, ZW.
- (21) International Application Number: PCT/US99/13852
- (22) International Filing Date: 18 June 1999 (18.06.1999)
- (25) Filing Language: English
- (26) Publication Language: English
- (71) Applicant: DYNAMIC TELECOMMUNICATIONS, INC. [US/US]; 3rd floor, 12810 Wisteria Drive, Germantown, MD 20874 (US).
- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
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— With international search report.
- (74) Agents: ROBERTS, Jon, L. et al.; Roberts Abokhair & Mardula, LLC, 11800 Sunrise Valley Drive, Suite 1000, Reston, VA 20191-5302 (US). For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: WIRELESS LOCAL DISTRIBUTION SYSTEM USING STANDARD POWER LINES



(57) Abstract: A system and method to connect standard telephone subscriber equipment (telephone, facsimile, personal computer) to a fixed wireless terminal via power lines. The system comprises fixed wireless terminals connected to a power line interface device. Subscriber equipment is connected to the power line interface device thereby allowing telecommunication signals to be transmitted to the fixed wireless terminal for subsequent wireless transmission. The fixed wireless terminal exists at an individual subscriber's home/business within a given step-down power transformer cluster. The step-down power transformer provides signal isolation so that the same or similar addresses can be used between clusters without confusion as to the identity of the individual subscriber. The FWT is also connected to the power meter at a subscriber location such that power utilization can be communicated to the power company in a wireless fashion.

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WIRELESS LOCAL DISTRIBUTION SYSTEM USING STANDARD POWER LINES

Inventor: Paul A. Kline

1 Background of the Invention

2 The present invention relates generally to wireless communications. More
3 specifically the invention describes a method and apparatus for using the power lines that
4 exist in a home or business to connect to a fixed wireless terminal for subsequent
5 transmission of telecommunications.

6 **Background**

7 In many undeveloped areas and undeveloped countries wireless communications
8 offers a sane method of providing communication without the need for major expenditures of
9 funds for outside-plant communications infrastructure (i.e. telephone poles, lines, other
10 facilities). However, even with certain so-called "wireless" systems, some communications
11 wiring is still required within a home or business so that communications equipment can be
12 connected to the fixed wireless terminal. Once communications to the wireless terminal are
13 established, the wireless terminal can communicate in a true wireless fashion to other
14 wireless terminals or to a base station thereby avoiding the more extensive outside-plant
15 communications infrastructure.

16 While electrical power in various forms has reached many homes throughout the
17 world, parallel communications wiring has not been so extensively installed. Therefore in
18 many third-world countries power wiring may exist within a home or business but
19 communications wiring might not. This poses a significant barrier to many individuals and
20 businesses who must install communications wiring in order to be able to communicate via
21 conventional wired communications equipment or the new wireless terminals.

1 In addition to the in-home/in-business communications wiring required, the present
2 topology for fixed wireless terminals requires that a transceiver be installed in each user's
3 location. It is not now possible to have multiple users at different locations take advantage of
4 the communications capability of a single fixed wireless terminal (FWT).

5 It is therefore the object of the present invention to utilize the power lines that are
6 installed in homes and businesses as a way to interface with fixed wireless terminals to
7 conduct subsequent wireless telecommunications.

8 It is a further object of the present invention to interface multiple types of
9 telecommunications equipment (e.g. telephone, fax, computer) to the power line in a home or
10 business where power lines are in turn connected to a fixed wireless terminal for subsequent
11 wireless telecommunications.

12 It is yet another object of the present invention to allow multiple users (i.e. different
13 homes or businesses) having a plurality of telecommunications equipment to interface with a
14 single FWT via power lines for subsequent wireless telecommunications.

15 It is another object of the present invention to provide an interface for the fixed
16 wireless terminal to the power meter attached to the power wiring in a home or business to
17 communicate power utilization to the power company in a wireless fashion.

18 The wireless local loop distribution system (the present invention) uses standard
19 power lines in a home or business to communicate with a fixed wireless terminal. In this
20 fashion the telecommunications equipment attached to the power lines can use the FWT to
21 communicate in wireless fashion to other FWT's in a network or to a base station.

22 In many countries there is little telecommunications infrastructure. Telephone and
23 other data wiring simply does not exist in homes or business. Simultaneously, however,

1 electrical power lines have been installed in many third-world or developing countries. Use
2 of these power lines provides a cost-effective method of rapidly deploying a wireless local
3 loop system which depends upon power lines for communication with an FWT.

4 In an electric power distribution system, step-down power transformers are used by a
5 company to convert higher voltage of several kilovolts to the 110/120 volts required by the
6 home. While several homes may be connected to each step-down power transformer, the
7 transformer effectively isolates the homes or business connected to it. This is referred to as a
8 transformer cluster. As a result, any communications signals flowing over the power lines
9 are effectively isolated by the local step-down power transformer.

10 The present invention employs a power line interface device (PLID) which provides
11 all of the interface capability necessary to connect plain old telephone service (POTS) via, for
12 example, an RJ11 plug, RS-232 ports for computer communication and exchange of data via
13 the TCP/IP protocol. Using a single PLID attached to the internal power wiring of a home, a
14 user can connect a telephone, fax, or computer to the PLID which in turn is connected to the
15 internal power wiring of the home. Also attached to the power wiring of the home is a fixed
16 wireless terminal (FWT). The FWT communicates with the telecommunications equipment
17 in a wireless fashion.

18 Thus the present invention allows the internal power wiring of homes to serve as the
19 means by which telecommunication signals are sent to the FWT for subsequent
20 telecommunications. An alternative topology can also be supported by the present wireless
21 invention whereby multiple homes or businesses are connected to a single FWT with no
22 multiplexing capability. The single FWT can then serve the telecommunication needs of
23 several homes or businesses simultaneously provided that those businesses are all located

1 within the local transformer cluster. This type of topology further reduces the cost of
2 wireless telecommunications since a single FWT can serve the needs of several homes or
3 businesses at the same time. The present invention achieves significant savings in several
4 fashions. First, telecommunications wiring within a home or business is avoided. The
5 present invention simply relies upon the power lines already installed within the home or
6 business. Further, having several homes or businesses using the same FWT results in
7 additional savings since the more expensive FWT's are required for a group of subscribers as
8 opposed to one FWT for each subscriber. These advantages and others will be obvious to
9 those skilled in the art after review of the detailed description of the present invention which
10 follows:

11 **Brief Description of the Drawings**

12 Figure 1: Typical Power/Communications Installation

13 Figure 2: Using Power Wiring for Telecommunications

14 Figure 3: Alternative Topology for Using Power Lines for Telecommunications

15 Figure 4: Another Alternative Topology for Using Power Lines for Wireless
16 Telecommunications

17 Figure 5: Block Diagram Using Power Lines as Telecommunication Distribution
18 System

19 Referring to **Figure 1** a typical power/communication installation in the home or
20 businesses is shown. The power company distributes power over its network to a series of
21 step-down power transformers **102**. A single step-down power transformer **102** can serve the
22 needs of several homes or businesses. In general however the power line from the step-down
23 power transformer **102** passes to an electrical meter **104** at the individual home or business.

1 Thereafter power is distributed over internal power wiring to various appliances
2 (106,108,110) which could be electrical equipment of a wide variety of types.
3 Simultaneously the telephone company 112 provides wiring over its network directly to the
4 home to which may be attached the telephones 114, faxes 116, computers 118. Thus it can be
5 seen that two separate systems are required to provide power and telecommunication services
6 to an individual home or business.

7 Referring to **Figure 2** an installation is shown using the power wiring for
8 telecommunications. The power company delivers power usually in the several kilovolt
9 range to a step-down power transformer 200. The transformer steps down the voltage down
10 (e.g. to 110 volts or 120 volts) as required and provides that power over power line 202 to a
11 power meter 204 located at a home or business. Thereafter power is provided internally to
12 the home or business over internal wiring 208. In the present invention an FWT 206 is
13 connected in parallel to the wiring 208. The power line interface device (PLID) 210 of the
14 present invention is connected to the internal power wiring 208. The PLID provides interface
15 means for plain old telephone service (POTS), and data through for example a RS-232 port or
16 Ethernet connection. Thus a user can connect a telephone 212, a fax 214 and/or a computer
17 216 to the PLID 210. A user can have multiple PLID's within any particular installation.
18 This type of installation eliminates the need to wire the subscriber's premises for
19 telecommunications. Currently, the internal wiring of a home or business will typically
20 support data rates of up to 100 kilobits per second with 10^{-9} bit error rate (BER), however this
21 may increase in the future.

22 The power company's step-down power transformer provides isolation which is
23 critical since each device on the power line in the home or business has a unique address and

1 since only a limited number of devices may be connected to the power lines within each
2 cluster within a transformer area.

3 Referring to **Figure 3** a power line telecommunication distribution system for
4 multiple subscribers is shown. Power is provided by the power company to the local step-
5 down power transformer **300**. Thereafter power is sent to individual homes/businesses **310**,
6 **312**, **314**. An FWT **308** is attached to the external power wires **302**, **304**, **306** which go to the
7 individual homes/business. The external power wiring is then connected to a typical power
8 meter **320** and proceeds to the internal power wiring of the home or installation **328**. PLID's
9 **316**, **318** are attached to the internal power wiring allowing the interface of telephones **322**,
10 fax **324**, and computers **326** to the PLID's. The PLID's are in turn connected to the internal
11 power wiring **328**. Communication is then effected by signals being sent by the
12 telecommunications equipment (telephone, fax and computers, etc.) via the PLID to the
13 internal wiring. However, in this instance the signals from multiple homes/businesses are
14 then routed through the FWT **308** for subsequent transmission. The FWT has the ability to
15 multiplex signals coming from the individual homes/businesses **310**, **312**, **314**. In this
16 fashion a single FWT can serve the needs of multiple homes/businesses thereby further
17 driving down the cost of telecommunications.

18 Referring to **Figure 4** an installation for use of FWT's for homes/businesses having
19 telecommunications wiring is shown. The present invention works equally well and
20 economically for those homes/businesses which do have internal telecommunications wiring.
21 In this case telecommunications equipment **426**, **428**, **430** are connected to internal
22 communications wiring **424**. The internal communications wiring **424** is in turn connected to
23 a PLID **418** which is connected to the power meter **416**. The power meter is the standard

1 power meter that measured power utilization at a home or an installation.

2 Telecommunication signals are sent via the PLID over power lines 404, 406, 408 to
3 an FWT 402 at the same location as the power company transformer 400. The power
4 company step-down power transformer 400 provides isolation of signals such that
5 telecommunication signals stay within the transformer cluster. The FWT then multiplexes
6 telecommunication signals and transmits those in wireless fashion to other wireless
7 communications capabilities.

8 The above topology allows the reuse of the same address within a transformer cluster
9 as is used in other transformer clusters. Since isolation is provided by the step-down power
10 transformer there is no danger of the same address causing confusion as to the identity of the
11 actual subscriber.

12 The FWT comprises a transceiver such as the Dynaloop family of transceivers from
13 Dynamic Telecommunications, Inc. of Germantown, Maryland and a power network
14 interface module such as the AN1000 from Adaptive Networks, Inc. of Cambridge,
15 Massachusetts. The transceiver interfaces between the wireless network and the power
16 network. Subsequent wireless communication can be either with a base station or with
17 another FWT as in a peer to peer communications network, or any other wireless network
18 scheme.

19 Each PLID has a power network interface and a subscriber equipment interface. The
20 power network interface is the same type as is used in the FWT.

21 Referring to **Figure 5** a general block diagram of the system is shown. As noted
22 earlier the power line transformer 500 receives high voltage from the power company and
23 provides isolation for communications signals coming from a transformer cluster. This

1 allows for re-use of the same address on power lines between different transformer clusters.

2 The FWT comprises a power network interface 502 and a transceiver 504. As noted earlier,

3 this transceiver is of the Dynaloop family of transceivers available from Dynamic

4 Telecommunications, Inc. of Germantown, Maryland. The power network interface module

5 such as an AN1000 from Adaptive Networks, Inc. of Cambridge, Massachusetts is also used.

6 The transceiver 504 interfaces between the wireless network and the power line network. All

7 telecommunication signals exist on the power lines between the power line step-down power

8 transformer and the individuals home/businesses. The power line 506 provides the means of

9 transmitting telecommunication signals from homes or businesses to the transceiver 504. The

10 FWT is connected to PLID's in the network 526, 528 via the power line 506. The PLID has a

11 power network interface 508 and a subscriber interface 510 (in this case a data interface is

12 shown). The PLID is thereafter connected to a computer 512. Alternatively in a telephone

13 installation, the power network interface 514 is connected to a subscriber line interface 516

14 (in this case a telephone PLID is shown). Connected to the POTS PLID is a telephone 518, a

15 fax 520, a modem 522 which in turn is connected to a computer 524. Individual pieces of

16 equipment or groups of equipment can be connected in the manner shown.

17 A significant additional advantage to this system is the fact that the FWT has a

18 connection to the power company's power meter. In this fashion individual FWT's can

19 receive information directly from the power meter at individual homes or businesses and

20 communicate that power utilization information in a wireless fashion to the power company.

21 Thus not only does the present invention provide for inexpensive means for

22 telecommunication but also provides an additional advantage to the power company to send

23 utilization information to it without the need for sending trucks and meter readers to record

1 the required power utilization information.

2 A flexible inexpensive wireless communications network using power lines has been
3 shown. Other specific pieces of equipment may be used to accomplish the same
4 communications goals and objectives of the present invention without departing from the
5 spirit of the invention as disclosed.

1 **Claims**

2 What is claimed is:

- 3 1. A wireless local distribution system using standard power lines comprising:
- 4 (a) a step-down power transformer;
- 5 (b) external power lines connected to the step-down power transformer;
- 6 (c) a transformer cluster formed by the step-down power transformer and
- 7 external power lines;
- 8 (d) subscriber facilities comprising internal power lines connected to the
- 9 external power lines;
- 10 (e) at least one power line interface device connected to the internal power
- 11 lines further comprising interface means;
- 12 (f) telecommunications equipment providing signals connected to the power
- 13 line interface device interface means;
- 14 (g) fixed wireless terminal equipment connected to the power lines adapted to
- 15 provide wireless communication;
- 16 and wherein the step-down power transformer provides signal isolation
- 17 within the transformer cluster.
- 18 2. The wireless local distribution system using standard power lines of claim 1,
- 19 wherein the power line interface device interface means is adapted to
- 20 communicate using any communication protocol.
- 21 3. The wireless local distribution system using standard power lines of claim 2,
- 22 wherein the power line interface device interface means is adapted to connect
- 23 to plain old telephone service.

- 1 4. The wireless local distribution system using standard power lines of claim 2,
2 wherein the power line interface device interface means is adapted to connect
3 to facsimile equipment.
- 4 5. The wireless local distribution system using standard power lines of claim 2,
5 wherein the power line interface device interface means is adapted to connect
6 to modem.
- 7 6. The wireless local distribution system using standard power lines of claim 2,
8 wherein the power line interface device interface means is adapted to connect
9 to a computer data port.
- 10 7. The wireless local distribution system using standard power lines of claim 1,
11 wherein the power line interface device is adapted to connect to the internal
12 power lines.
- 13 8. The wireless local distribution system using standard power lines of claim 1,
14 wherein the power line interface device is adapted to connect to the external
15 power lines.
- 16 9. The wireless local distribution system using standard power lines of claim 1,
17 further comprising a power meter connecting the external and internal power
18 lines.
- 19 10. The wireless local distribution system using standard power lines of claim 9
20 wherein the fixed wireless terminal equipment is adapted to connect to and
21 receive signals and information from the power meter and transmit those
22 signals or information to the power company.
- 23 11. The wireless local distribution system using standard power lines of claim 1,

1 wherein the fixed wireless terminal equipment is adapted to provide
2 telecommunication signals for a single subscriber facility via the power lines.

- 3 12. The wireless local distribution system using standard power lines of claim 1,
4 wherein the fixed wireless terminal equipment is adapted to provide
5 telecommunication signals for a plurality of subscriber facilities via the
6 external power lines.

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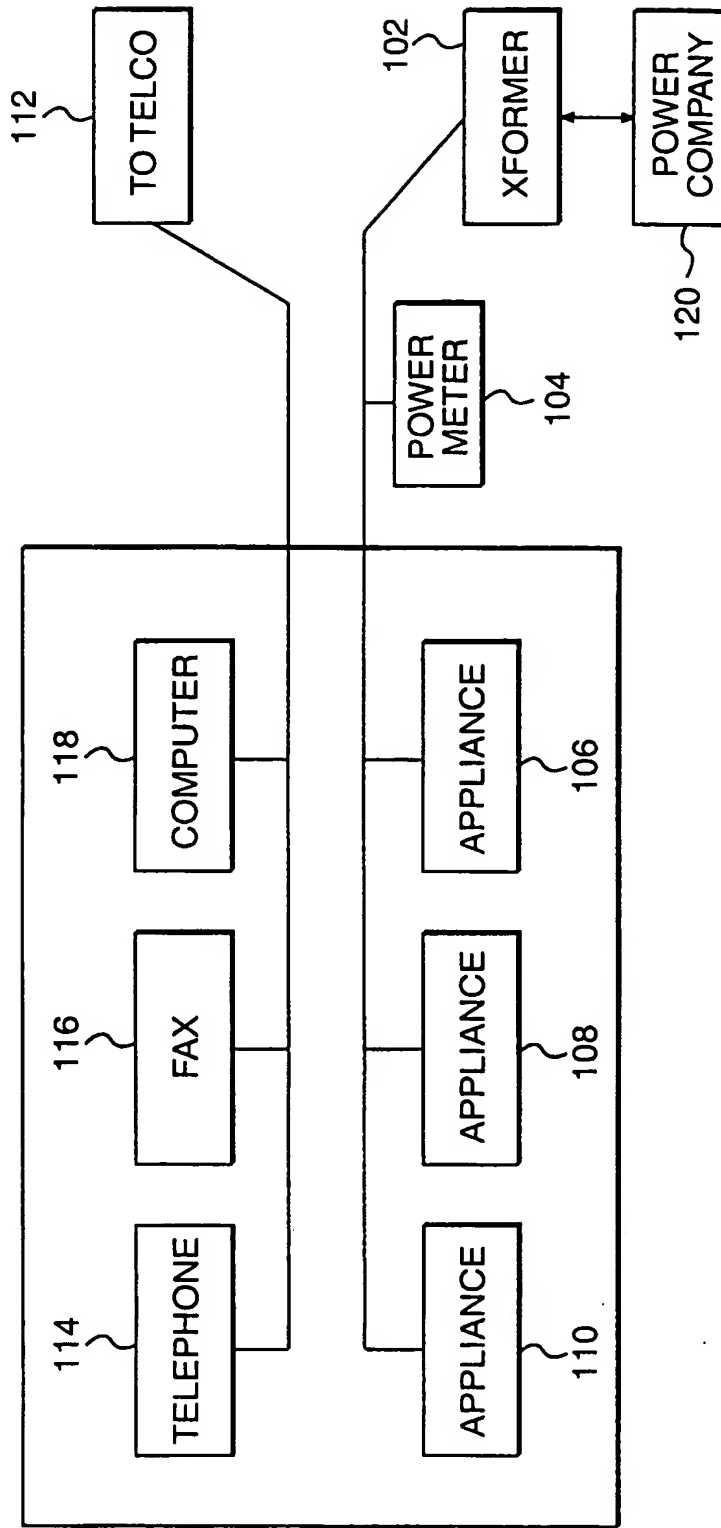


FIG. 1

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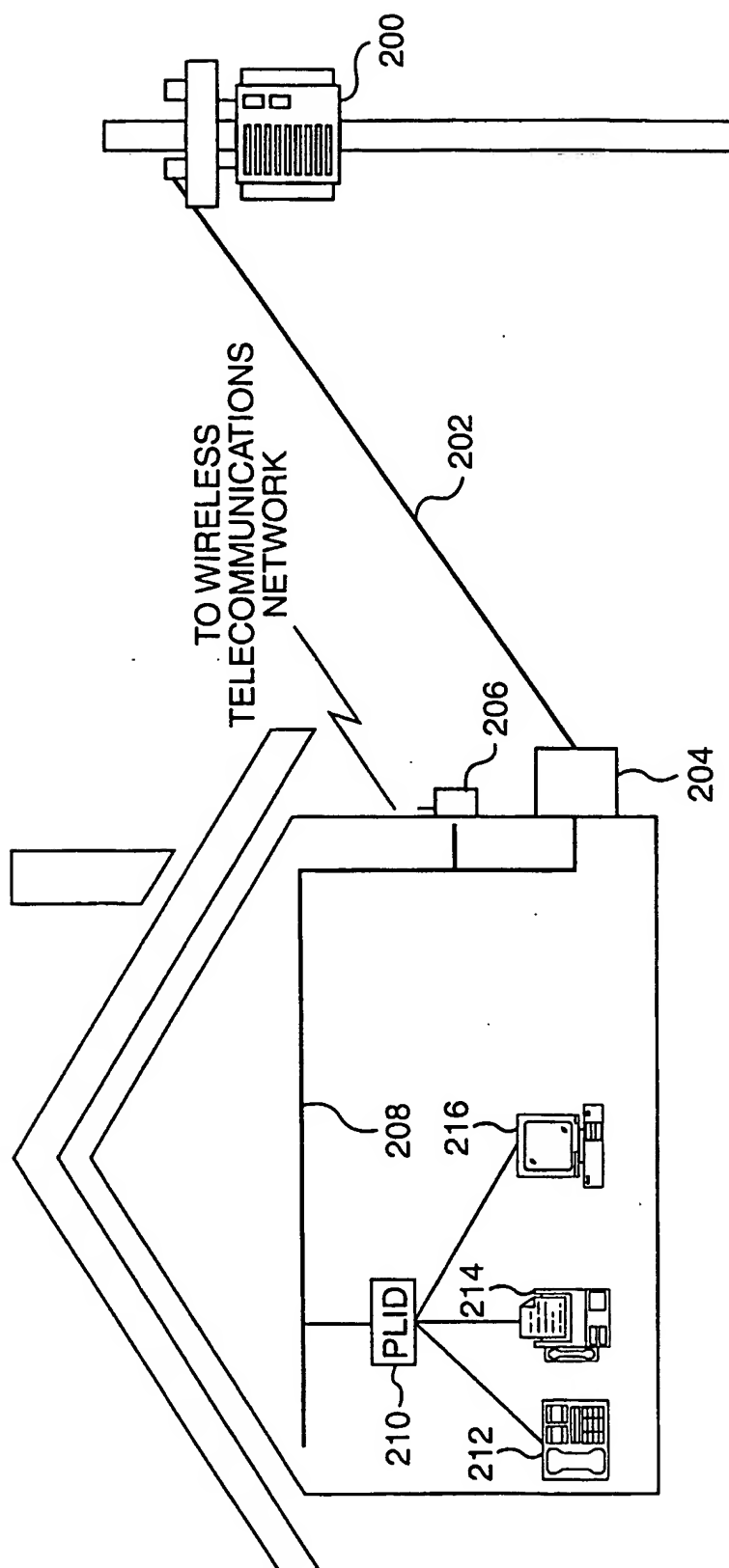


FIG. 2

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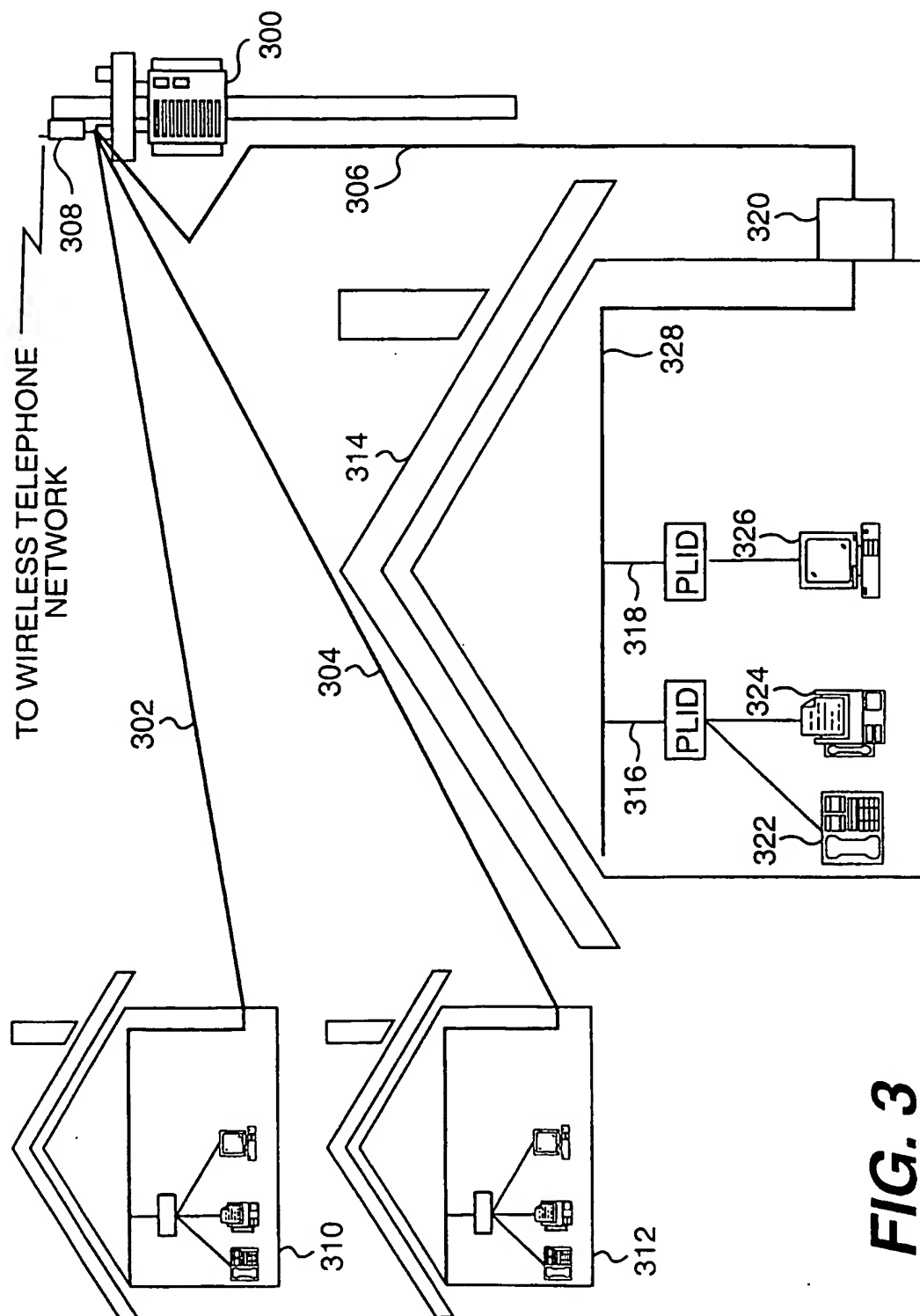


FIG. 3

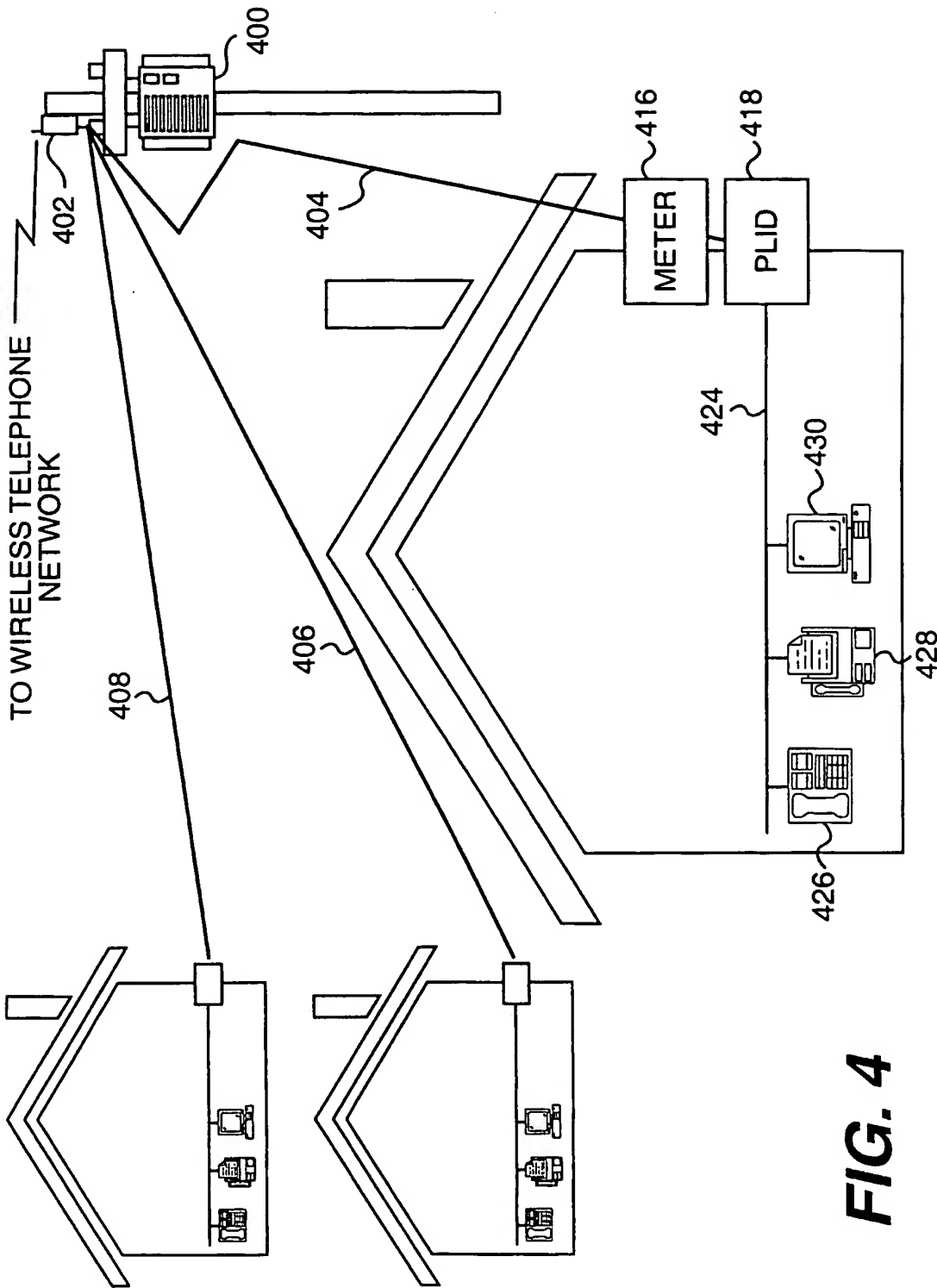


FIG. 4

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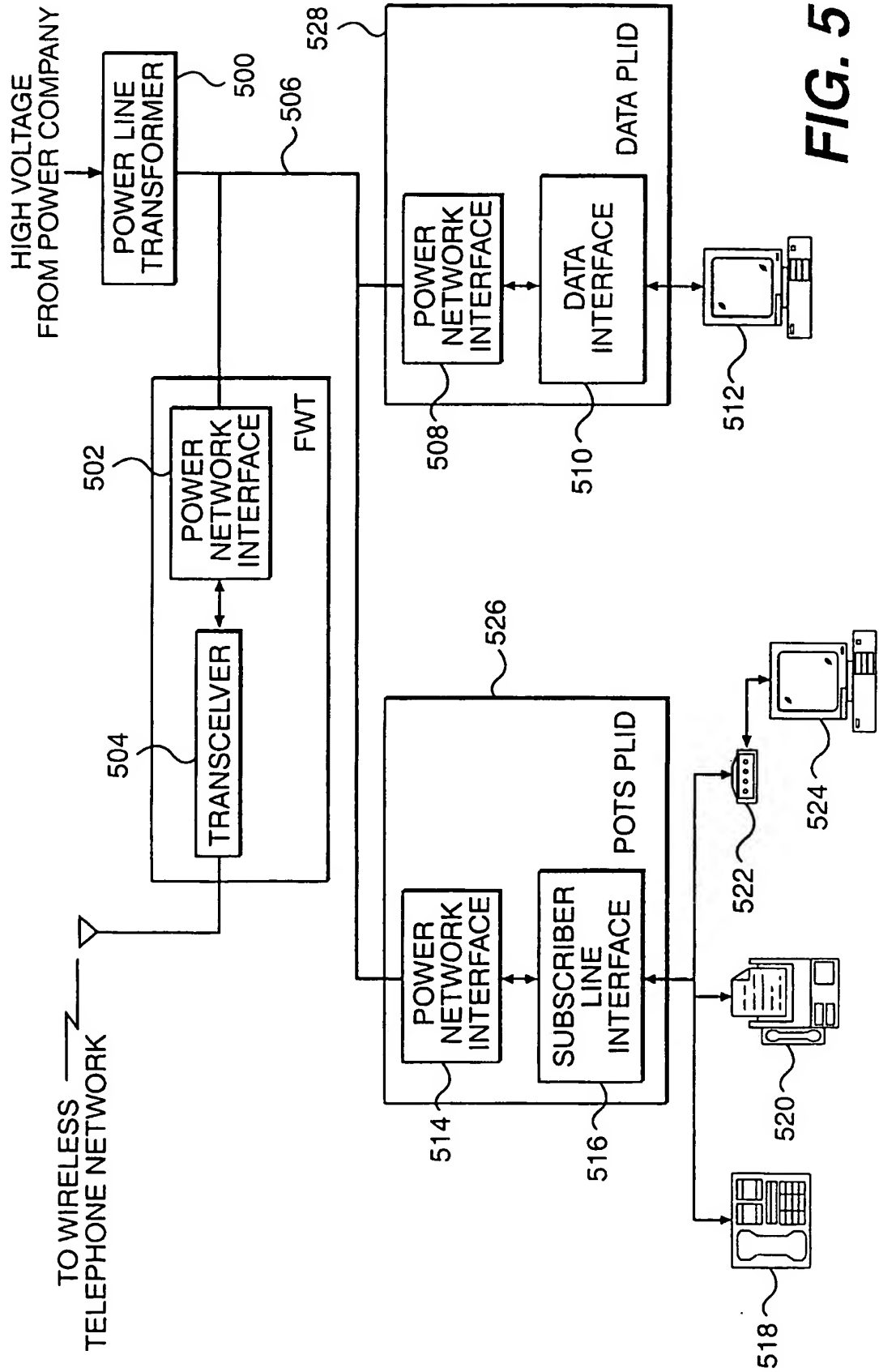


FIG. 5

INTERNATIONAL SEARCH REPORT

Inter national Application No

PCT/US 99/13852

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 H04B3/54 H04B3/56

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 IPC 7 H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 913 955 A (NORWEB PLC) 6 May 1999 (1999-05-06) column 1, line 53 -column 2, line 4 column 2, line 51 -column 3, line 4 column 3, line 22 - line 25 column 4, line 46 - line 52 column 10, line 21 - line 44; figure 1 column 11, line 28 - line 40 -----	1-12
A	US 5 319 634 A (BARTHOLOMEW DAVID B ET AL) 7 June 1994 (1994-06-07) column 1, line 18 - line 40 column 6, line 61 -column 7, line 11; figure 2 -----	1-12
A	US 5 770 996 A (MEIDL RICHARD M ET AL) 23 June 1998 (1998-06-23) abstract -----	1-12

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

4 February 2000

Date of mailing of the international search report

11/02/2000

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

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